APPENDIX C

Tri-Service Automated Cost Engineering Systems

C-1 General.

a. This appendix provides information on the Tri-Service Automated Cost Engineering Systems (TRACES), which is the umbrella linking all automated cost engineering systems and their associated databases. The Tri-Service Committee on cost engineering is the proponent for all the major components of TRACES. The assigned responsible agency for TRACES is the U.S. Army Engineering and Support Center, Automated Systems Branch, TRACES group, Huntsville, Alabama (https://www.hnd.usace.army.mil/TRACES/). The assigned responsible agency serves as the focal point for support usage of these software programs by providing operation, maintenance, and "Hot-Line" telephone support.

b. Detailed guidance on the use of each system can be found in the appropriate system user manual for each software program. The appropriate policy guidance on the use of automation in developing cost estimates is provided in the specific agency cost engineering regulations.

c. The entire system seeks to provide a user-friendly cost engineering platform in a standard environment that will provide the cost engineer the tools to prepare, review, and maintain all types of cost estimates. Software for scheduling construction projects is also linkable to TRACES. Figure C-1 depicts the major components of TRACES.

C-2 Use of Automated Systems. The use of cost engineering automated systems enhances the efficiency, accuracy, and credibility of project cost estimates. Automation assists in the standardization of estimating procedures and provides estimates that are easily reviewed, revised, and adapted to new projects or situations. Standardization assists in collection and analysis of historical costs that can be used to develop budget estimates for cost comparison purposes, for reporting and tracking of project cost data, and for the building of parametric models.

a. Software Updates and New Systems. Automation continues to develop at a rapid pace. Minor upgrades may occur annually and major system changes every 2 or 3 years. Major new systems may be fielded at any time. Cost engineers should ensure that they are using the latest available software versions.

b. Limitations of Automation. Automation is a tool, and even the best cost automated system is not a replacement for good estimator judgment. The cost engineer should always be knowledgeable of the system’s capabilities and limitations in relation to a project. The cost engineer must be especially careful in using models,

parametrics, average unit rates and prices, cost books, and in adopting existing estimates to new projects. The automated information sources, especially in critical and major cost areas, should be further studied for reasonableness as related to the specific project under development. Estimate output should be checked for reasonableness. Assumptions and methodology should be verified and documented.

C-3 Major Automated Systems and Modules. TRACES includes the following major systems/modules: a detailed quantity takeoff, cost engineering system referred to as Microcomputer Aided Cost Engineering System (MCACES); a parametric system for the preparation of less than fully detailed design estimates for military construction projects referred to as Parametric Cost Engineering System (PACES); a historical cost analysis generator (HAG) to collect, store, and analyze historical cost data for facilities and site work; a location area cost factor (ACF) system to adjust average historical facility costs to a specific project location; a Cost Engineering Dredge Estimating Program (CEDEP); a life cycle cost (LCC) module for analysis of system design alternatives; a parametric system for preparation of Hazardous, Toxic, and Radioactive Waste (HTRW); budgetary estimates called Remedial Action Cost Estimating Requirements (RACER); a scheduling interface (SI) module; and risk analysis systems.

a. Microcomputer Aided Cost Engineering System. MCACES is a multi-user software program for the preparation of detailed construction cost estimates for military, civil works, and HTRW programs. The system also includes a project database and supporting databases. The supporting databases include Cost Book, crews, assemblies, labor rates, equipment ownership schedule costs, and models. All databases work in conjunction with each other to produce a detailed cost estimate. The databases are described in the MCACES user manual.

b. Parametric Cost Engineering System. PACES is a parametric cost estimating system, which is used primarily for development of programming or budgetary cost estimates in support of Military Construction Programs such as military facilities, family Housing, medical, and operation and maintenance projects. PACES is a comprehensive program incorporating cost models for new construction, alteration, and renovation. The system uses a parametric methodology adjusting cost models for estimating project costs. The cost models are based on generic engineering solutions for building and site work projects, technologies, and processes. The generic engineering solutions were derived from historical project information, government laboratories, construction management agencies, vendors, contractors, and engineering analysis. PACES provides the capability to prepare cost estimates of military projects based on past designs on less than fully detailed design information. It uses the appropriate Work Breakdown Structure (WBS), a database of models and assemblies from historic projects, and a series of detailed linking algorithms used to develop a cost estimate. If desired, the estimate can be transferred to MCACES or SUCCESS™ for

task-by-task analysis of the cost estimate. PACES is the U.S. Air Force's primary tool for preparing programming estimates.

c. Historical Cost Analysis Generator Software/Module. HAG is a stand-alone software/module, which is used to collect and display historical cost data from awarded projects. HAG uses the standard WBS structure to track historical bid costs by type, location, size, and time and has the capability of automatically normalizing and adjusting awarded costs. The HAG system also provides a vehicle to retrieve selected statistical cost information from the historical cost database for use in the preparation of programming or budgetary cost estimates.

d. Area Cost Factor Program. The ACF program calculates the area cost factor index for each specific location based on material, labor, and equipment index and matrix factors. At a given installation, the combination of local labor, material, and equipment costs has the largest impact on total construction cost. Therefore, a comparison of the local labor, material, and equipment project costs for typical military construction at different cities would give a comparison of relative construction costs. A market basket of 10 labor crafts, 20 materials and 4 pieces of construction equipment, and 7 matrix factors for each location are used in the calculation of the ACF index.

e. Cost Engineering Dredge Estimating Program.

(1) The CEDEP is a stand-alone program used for the preparation of pipeline, hopper, and mechanical dredge estimates. Two support data files are also provided within CEDEP. The CHECKRATE support program also included in the CEDEP is a computerized version of the Dredge Ownership and Operating Rate Worksheet, chapter 4 of Engineer Pamphlet 1110-1-8, *Construction Equipment Ownership and Operating Expense Schedule*.

(2) CEDEP is a comprehensive software package that allows the user to prepare estimates for dredging. Three separate Microsoft Excel® templates are available. Clamshell CEDEP, which is used to create estimates using mechanical type dredge, Hopper CEDEP, which is used to create estimates using hopper dredge plant, and Pipeline CEDEP, which is used to create estimates using cutter head type dredge.

f. Life Cycle Cost Module. The LCC module is a stand-alone program designed primarily to conduct LCC analyses among competing design alternatives for a given project providing a record of the results. The program comes with an extensive maintenance and repair (M&R) database tailored for U.S. Army buildings. Estimates of construction/acquisition costs can be transferred electronically into the LCC module from any MCACES Gold project estimate. The most prominent capabilities are: (1) to conduct LCC analyses in accordance with the provisions of statutes, regulations, and requirements; (2) to calculate the present worth of individual building or facility

components; and (3) to compare M&R costs for building components in the M&R database.

g. Remedial Action Cost Estimating Requirements System. RACER is a parametric cost estimating system, which is used primarily for development of programming or budgetary cost estimates for environmental projects. The RACER system provides engineers, managers, estimators, and technical support personnel an easy-to-use tool to quickly develop budget estimates for environmental projects when little or no design information is available to develop a detailed cost estimate. The system is a comprehensive program incorporating cost models for studies (PA/SI, RI/FS and RFI/CMS), remedial design, remedial action, operations and maintenance, long term monitoring, and site work and utilities. The system uses a parametric methodology for estimating costs. The cost models are based on generic engineering solutions for environmental projects, technologies, and processes.

h. Scheduling Interface Module. The SI module is a stand-alone program that provides project scheduling capabilities for MCACES or SUCCESS™ cost estimates. The SI module produces a pure logic sequencing of project activities for scheduling purposes. The module also allows export of this data to various scheduling software packages for the development of more detailed scheduling functions. The scheduling data produced by the SI module is stored with the MCACES/SUCCESS™ estimate (Project Database) and can be saved as a master template or as a model for future use by other projects.

i. Risk Analysis Systems

(1) Crystal Ball® Software. For civil works, 2007 Headquarters U.S. Army Corps of Engineers guidance requires utilization of a Monte Carlo theory, i.e., statistical-based risk software known as Crystal Ball® to study risks for contingency development. This replaces previous software programs for civil works estimates. This requirement is “for all decision documents requiring Congressional authorization for projects exceeding $40 million.” This guidance statement refers to the total project cost, normally established at the feasibility stage; however, during any critical period of the project, a risk analysis may be prudent to highlight areas of concern that may be “mitigated” to lessen risk to cost and schedule. The advantage of the risk analysis process is that it includes all major project delivery team members with respect to all costs and features related to the total project cost. This risk analysis process provides a forum for discussion whereby the members meet to discuss risk potentials that may adversely impact the project. Moreover, those meetings may also highlight opportunities that the team finds advantageous for the project. Value engineering studies may also be an outcome of these meetings.

(2) COSTRISK. The Risk Analysis Systems (CostRisk) software program provides the capability to assess risk and uncertainty associated with any Military, Civil Works, or HTRW project cost estimate at any time during the project life cycle period. This process of "probability based" estimating can be used to revise estimates based on "confidence levels" and can assist in the evaluation of project contingency funds. The CostRisk software is designed to work with TRACES parametric cost estimating programs (PACES and RACER). In addition to these interfaces, CostRisk is capable of performing a cost risk analysis on any cost estimate that is developed in Microsoft Excel®. CostRisk performs cost risk analysis on the construction cost estimates using Monte Carlo simulation techniques as the basis of its calculations.

j. Other Systems. The need to integrate cost estimating tools with agency specific program/project management systems has led to the development of several cost estimating tools and modules. Some of these tools are stand-alone programs designed primarily for a specific requirement and for use by base/installation personnel, which include PC-Cost, Department of Defense Form 1391 (for Army users); SUCCESS, PCEM, Department of Defense Form 1391 + Project Cost (for Navy users).

C-4 Databases and Files Used by TRACES Systems/Modules.

a. Cost Book Database. The Cost Book database, also referred to as the Unit Price Book (UPB) supporting the MCACES, is a collection of common construction detail line item tasks used in developing project estimates for military, civil works, and HTRW programs. The Cost Book is organized in accordance with the Construction Specification Institute numbering system. These material costs can be modified to reflect localized costs for other locations. Each task listed provides unit costs for labor, equipment, and materials. Localized Cost Books can be developed by modifying the key rates in the national Cost Book.

b. Models Database. This database contains groupings of assemblies for a whole facility or site work entity. Linkage between assemblies and assemblies to tasks are by WBS or as exists in a historic estimate. Linkage algorithms are provided to the cost engineer for project-specific estimate refinement. At the heart of the detail pricing is the Cost Book task costs. Using models can reduce the time for estimate preparation but relies heavily on past designs using default linkages.

c. Assemblies Database. The assemblies database stores common groupings of related work tasks, each representing a composite cost required to create a larger piece of a project rather than a single task. The individual cost items within each assembly are either extracted from the Cost Book or from the labor and equipment databases. The database is broken down according to the WBS. Each assembly includes parameter worksheets, requiring only input of parameters appropriate for the

specific job. Using assemblies can greatly reduce the amount of data entry required to build a project.

d. Other Databases. Other TRACES databases include the crews' database, labor rates database, and equipment rates database.

e. Work Breakdown Structure Data File. This data file provides a separate hierarchical work breakdown master structure for use as a template in formatting cost estimates for civil works, military, and HTRW projects.

f. Civil Works Construction Cost Index System. The Civil Works Construction Cost Index System (Engineer Manual 1110-2-1304) will be used to update unit prices and various project cost features to current price levels. Inflation factors published in Civil Works Construction Cost Index System for use in predicting future costs are based on those factors developed by the Office of Management and Budget. The factors are published by Headquarters U.S. Army Corps of Engineers, Programs Division, in the Engineer Circular for the Annual Program and Budget Request for Civil Works Activities.

g. Area Cost Factor Index. The ACF index is used in adjusting estimated costs to a specific geographical area. The factors reflect the average surveyed difference for each location in direct costs between that location and the national average location.

h. Historical Cost Analysis System. The Historical Cost Analysis System is a stand-alone system to store historical cost data for HTRW remedial action projects. Project costs are stored in the program using a Historical Cost Analysis System-developed category code and the Remedial Action WBS. The user may search the database by using the query function and specifying the type of media, type of contaminant, and type of technology. The search can also be narrowed by additional criterion such as contract types, geographic location, award date, HTRW Remedial Action WBS, etc. Project cost can be printed or exported to other programs.

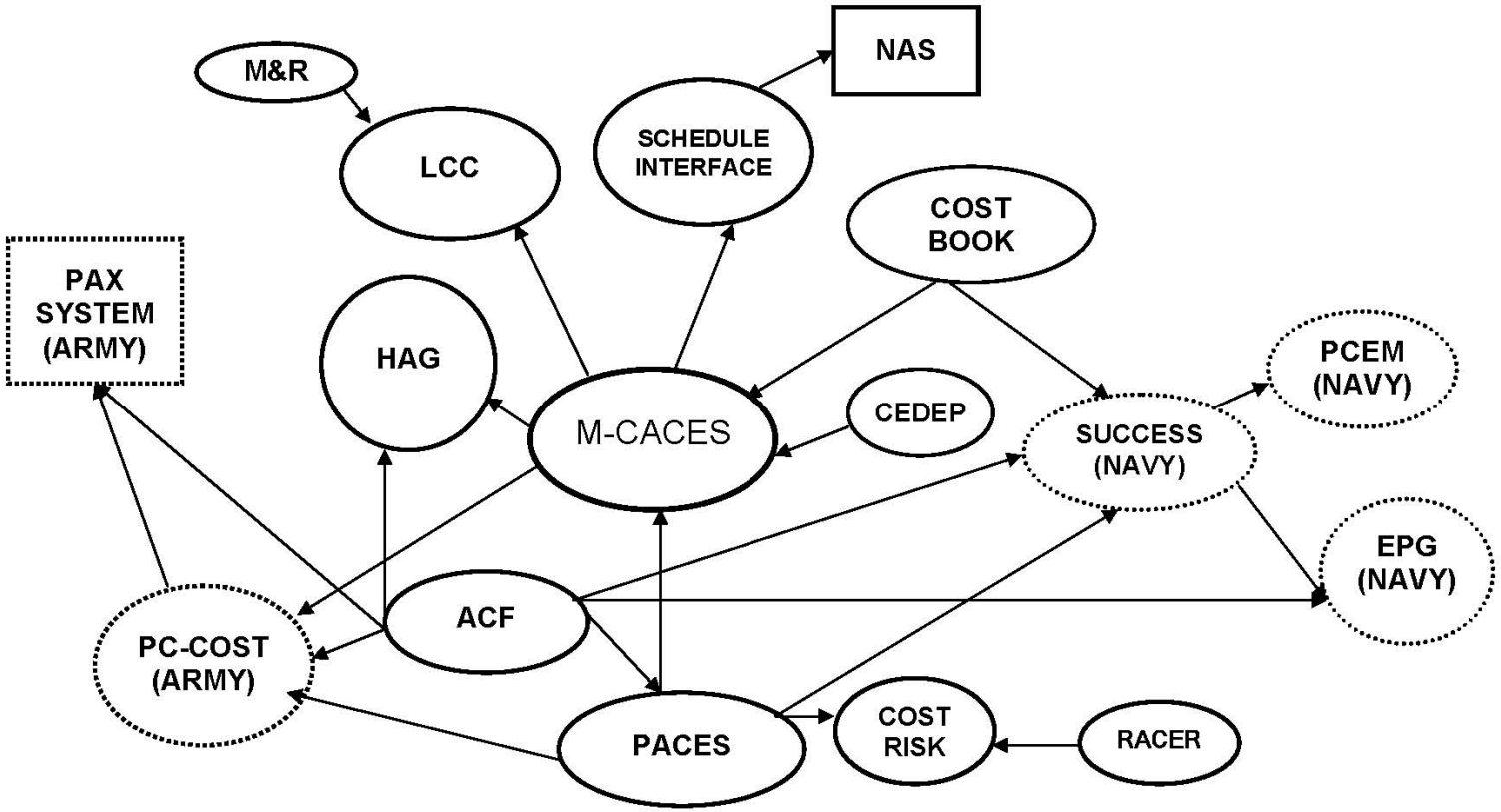

Figure C-1. Tri-Service Automation Cost Engineering Systems